



PREFERENCE OF MATHEMATICS LEARNING STRATEGIES BASED ON GENDER

Bishnu Khanal

PhD, Tribhuvan University, Kathmandu, Nepal.

ABSTRACT

This paper highlights the differences between boys and girls in their preference regarding learning strategies in mathematics. The study was conducted through a multistage sampling procedure with grade IX students in Nepal, 652 boys and 742 girls. The author adopted a mix method sequential explanatory design using a questionnaire, observations and interviews. The result shows that boys and girls have significant difference in their preferred learning strategies. Boys preferred elaboration, effort management and critical thinking strategies whereas girls preferred peer learning, help seeking and rehearsal strategies.

KEYWORDS: Preferred learning strategies, cognitive strategies, resource management strategies, gender, mathematics.

BACKGROUND OF THE STUDY:

In Nepal, mathematics is a compulsory subject up to secondary level (Grade IX and X) in school education which covers the areas of arithmetic, algebra, geometry, trigonometric ratios and its applications, statistics (measure of central tendency) and general concept of probability. It is taken as a difficult subject, and a mysterious subject. "Mathematics is only for clever people - and males"; "your father is a math teacher so you too must be good in mathematics". Such myths and images are widespread (Ernest, 1996). In Nepal, there are challenges to work as a mathematics teacher due to a large number of students having poor performance in the subject. Gender balance has been noted for a long time in Nepalese education. Mathema and Bista (2006) state, "The girls, on average, have lower scores than boys in every subject. And the difference in scores between the genders is greatest in Mathematics" (p. 52).

It would hence be worthwhile to explore whether the difference in their performance is associated with the selection of learning strategies in mathematics. Learning strategies are an individual's approaches to learn or solve a task. They are concerned with how a student organizes and uses a set of skills to learn content for accomplishing a particular task more effectively and efficiently either in or out of school (Schumaker & Deshler, 1984).

As taxonomy, learning strategies consist of cognitive strategies (rehearsal, elaboration, organization, critical thinking and metacognition) and resource management strategies (time and study management, effort management, peer learning and help seeking) (Pintrich, Smith & McKeachie, 1989). According to them, rehearsal refers to students' attempt to recall and repeat learning material, and elaboration includes summarizing information and putting ideas into one's own words. Organization is concerned with making connections across learning experiences, while critical thinking denotes how learners question or analyze the statements and concepts learned in the class. Similarly, metacognition is related to how students set learning goals and monitor/regulate the learning process. Likewise, time and study management refers to the learner's task of managing time and learning environment. Effort management is concerned with the students' commitment to achieve their learning goals even when there are difficulties. Peer learning includes the students' attempt to work with their friends/classmates; and help-seeking involves how students seek assistance from their teachers and classmates in the learning process.

Protheroe and Clarke (2008) state that effective use of learning strategies can greatly improve student achievement. To improve the academic performance of all students, teachers need to help students develop effective learning strategies that enable them to construct their own mathematical knowledge, discover relationships and find facts by using their own learning styles and strategies rather than memorizing mathematical formulas and procedures (Cangelosi, 1996). Gender has a significant effect on the choice of learning strategy. Research carried out by Oxford et al. (1996) indicates that gender has a significant effect on the frequency of strategy use. However, the study about gender difference in the preference of learning strategies in mathematics has not been carried out in an Asian context, particularly not in Nepal. This research investigated boys' and girls' preferred learning strategies in mathematics in Nepalese context.

RESEARCH QUESTIONS:

The study reported in this paper aimed to answer the following questions related to the learning strategies of secondary school mathematics students:

1. Are there any gender differences in students' preference of learning strategies in mathematics?

2. If so, what kinds of differences are there? And why?

METHOD:

A mixed method-sequential explanatory design (Creswell, 2014) was employed. Data were collected with a survey from 1394 students (652 boys and 742 girls) of Grade IX from 24 schools of three geographical regions of Nepal. This quantitative study was based on the learning strategies classified by Pintrich, Smith and McKeachie (1989) to answer the research questions. A Motivated Strategies for Learning Questionnaire (MSLQ) model developed by Pintrich, Smith and McKeachie (1989) was adapted for data collection. The questionnaire includes motivation scales and learning strategies scales, which can be used together or separately (Chang, 2010). In this study, only the learning strategies section was utilized. The learning strategies consisted of: (i) cognitive strategies (which include rehearsal with 4 items, elaboration with 6 items, organization with 4 items, critical thinking with 5 items, metacognition with 10 items), and (ii) resource management strategies (which include time and study management with 5 items, effort management with 3 items, peer learning with 3 items, and help seeking with 3 items). The learning strategies section of the MSLQ contains two categories with 43 items in 7-point Likert-type scale, ranging from 1 (not at all true for me) to 7 (absolutely true for me). Each item represents a statement concerning the use of a learning strategy. The learning strategies section of the MSLQ was translated into Nepali by the researcher with consultation of English and Nepali language experts.

The pilot test of the translated instrument was carried out in a small group of students. Overall, Cronbach's alpha reliability for internal consistency of all the 43 items was 0.85. Hence, from reliability point of view, the items were reliable enough to use in research. Then the instrument was administered to the students in order to identify the learning strategies of secondary school students. For each scale, score was calculated by taking the mean of the responses to all items in the particular scale. The data were analyzed by applying χ^2 - test through SPSS and interpreted from diagrams and tables.

For the qualitative study, the author employed observations and interviews. Observation guidelines were prepared prior to the observation; and accordingly 30 lessons were observed in two schools. Similarly, interview guidelines were prepared based on the learning strategies classified by Pintrich, Smith and McKeachie (1989). After the observations, 24 key respondents with equal number of boys and girls were selected for interviews from two of the schools. The respondents were interviewed individually and both video and audio recorded.

In this study, the data were approached accordingly; and the collected qualitative information from observation and interview were 'transcribed', 'encoded' and 'categorized thematically' (Creswell, 2014). The thematic categories were based on the learning strategies of rehearsal, elaboration, organization, critical thinking, metacognition, effort management, peer learning, and help seeking - taking gender difference into account every time. The information was critically analyzed substantiating with theory and the results of the previous studies. Then the quantitative and qualitative analyses were presented in sequential order - with the quantitative analysis and interpretation at first, followed by qualitative analysis and interpretation. During integration, coherent issues were agreed and conflicting issues were discussed and debated. To maintain reliability, validity and trustworthiness of the data, re-interviews were administered and recorded for cross-checking and triangulation with information obtained from prior interviews and class observation.

RESULTS:

The null hypothesis assumed by the research question was: Both boys and girls used all nine strategies in equal proportion. The chi-square test for goodness of fit was carried out to test the null hypothesis. Table 1 shows the comparison of the frequently used learning strategies of boys and girls.

Table 1: Frequency of the most used learning strategies by gender

| Selected Strategies | Gender | | Total |
|---------------------|--------|-------|-------|
| | Boys | Girls | |
| Rehearsal | 67 | 85 | 152 |
| Elaboration | 151 | 140 | 291 |
| Organization | 54 | 66 | 120 |
| Critical Thinking | 17 | 9 | 26 |
| Meta Cognition | 14 | 22 | 36 |
| Time and Study Mgmt | 35 | 33 | 68 |
| Effort Mgmt | 93 | 63 | 156 |
| Peer Learning | 140 | 214 | 354 |
| Help Seeking | 81 | 110 | 191 |
| Total | 652 | 742 | 1394 |

As Table 1 displays most of the boys used elaboration strategies whereas girls used peer learning. The second and third preferences of boys were peer learning and effort management strategies, but those of girls were elaboration and help seeking strategies. Most of the girls (29%) used peer learning in their study whereas most of the boys (23%) used elaboration. Altogether 22% of boys used peer learning, 14% used effort management, 12% used help seeking, 10% used rehearsal, 8% used organization, 5% used time and study management, 3% used critical thinking and 2% used metacognition strategies. Similarly, 19% of girls used elaboration, 15% used help seeking, 12% used rehearsal, 9% used organization, 9% used effort management, 4% used time and study management, 3% used metacognition and 1% used critical thinking strategies.

The chi-square test showed that the learning strategies used by boys and girls were significantly different at $p < 0.001$; so it was concluded that boys and girls used different learning strategies. However, all kinds of strategies were used at least by some percentage of students. There were marked differences between boys and girls in their interest and enjoyment of mathematics as well as in their self-related beliefs, emotions and learning strategies related to mathematics. With respect to students' use of learning strategies, boys consistently reported using elaboration strategies more often than girls, whereas girls reported using peer learning.

A girl (Sangita, February, 2013) claimed "While asking questions, I feel comfortable with my friends than with the teacher." In class observation also, the researcher found mostly girls talking with each other to solve their problems. Peer learning was the strategy which the girls mostly preferred while learning mathematics. Boys were found summarizing, taking notes, making charts and listing the important concepts. They tried to solve problems in their own ways. In the interview, a boy reported, "I often make the chart of formulas and stick on the wall of my room. I daily look at the chart even in leisure time." (Kiran, February, 2013) Another boy stated, "I try to solve problems using alternative methods also." (Naresh, February, 2013). Girls asked their teachers, family members and relatives, but they used effort management strategies lesser than boys. A girl asserted, "My father also helps me." However, a boy responded, "If I don't understand what the teacher teaches; I look into reference materials to understand then I try to solve problems myself." (Sambhu, February, 2013) These narratives showed that girls preferred help seeking strategies. Boys were more likely to take risk and used their own effort in solving problems in mathematics.

A girl admitted, "I often ask many questions to the teacher." (Laxmi, March, 2013) It was seen in the observation that girls were more likely to do more practice than boys. In this respect, girls preferred rehearsal strategy whereas more boys preferred critical thinking. Girls did a lot of practice, but thought less critically. Girls used less logical faculty whereas boys did less practice, so boys sometimes went to the extent of using different method to solve the problems. However, girls were more likely to be teacher dependent. One of the interviewee girls admitted, "I don't use alternative method, I follow the way my teacher had taught me." (Phurwa, March, 2013) One of the boys claimed, "Sometimes I compare my teacher's lecture and book and try to solve the problems myself looking at the worked out examples." (Debendra, February, 2013) This showed that boys tended to be independent while girls tended to be the teacher's followers. The above mentioned narratives and responses clearly showed that both boys and girls used all nine strategies, but girls were more likely to use peer learning, help seeking and rehearsal strategies more than boys. On the other hand, boys were more likely to use elaboration, effort management and critical thinking strategies than girls.

DISCUSSION:

Student survey consisting of 1394 observations with 24 key respondent interview and classroom observations were used in a mixed method-sequential explanatory design to predict learning strategies in mathematics from gender variable. The main objective of this study was to investigate the gender difference in the preference of learning strategies in mathematics in Nepal in such a way that (1) relatively more accurate estimates of the effects of gender, is generated than those reported in past studies, and (2) results remain generalizable at the national level.

The result showed significant differences in the learning strategies used by girls and boys while learning mathematics. There were marked differences between their interest and enjoyment of mathematics as well as in their self-related beliefs, emotions and learning strategies related to mathematics. Boys consistently used effort management, critical thinking and elaboration strategies more often than girls, whereas girls used peer learning, help seeking and rehearsal. As Grieb (1982) has stated, "Girls tend to memorize algorithms and specific solutions to the problems, whereas boys tend to evaluate and use more complex problem solutions." Similar findings are discussed by Fennema & Peterson (1985) who say, "Girls don't develop the type of autonomous learning strategies needed for complex problem solving in mathematics." This study showed that girls who tend to show greater avoidance of problem solving situations do not take risks; they rather memorize problems' solutions and request for assistance more than boys do. Rogers (1995) have explored the phenomenon of gender difference in students at all grades, levels of learning and achievement in mathematics. Girls began to feel uncomfortable and became disinterested in mathematics early in the educational process. The findings here indicate that we need to address girls' problems by encouraging and motivating them in mathematics right from their early stage of education.

Students' motivation, their positive self-related beliefs as well as their emotions also affected their use of learning strategies. It involved control of the learning process as well as the explicit checking of relations between previously acquired knowledge and new information, formulation of hypotheses about possible connections and the testing of these hypotheses against the background of the new material. Learners were willing to invest such effort only if they had a strong interest in a subject, which determined the effective ways of selection of learning strategies. A repertoire of strategies combined with other attributes that fostered learning developed gradually from the activities aimed at building a scaffolding structure of learning, which were taken as students' self-regulated learning strategies. The findings of researchers including Grieb (1982) and Fennema & Peterson (1985) reported above have implicitly pointed out that boys are more likely than girls to assume control for their learning and to evaluate different problem solutions. Girls, on contrary, tend to show greater avoidance of problem-solving situations, take fewer risks, memorize problem solutions, and request for more assistance than boys. This was confirmed in this study.

For the selection of different learning strategies, cultural factor can also be one of the reasons. The boys' and girls' preference in learning strategies reflected their cultural practices in Nepalese society. Girls prefer peer learning and help seeking as they feel comfortable to share with peers. This finding is supported by the study of UNESCO (2005) which mentions "girls tend to learn in groups and boys individually in schools (p. 33)." They do not give enough time at home for practicing mathematics as they have some responsibilities at home. The same report states "the socio-culturally inherited expectation from girls and economic value of girls especially in mountain districts of Nepal provided very little time for the girls to study the "difficult subjects" like Science and Math (p. 35)." Thus, they wish to ask their seniors in case of confusion, whereas boys want to become more independent and accordingly they use their time in effort management, time and study management, and critical thinking. But, girls like to be interconnected with their peers and seek help from other 'tutorial support' (UNESCO, 2005) – which is reflected in their dependency in the process of learning as well.

Nevertheless, we should not deny the fact that all the nine learning strategies are used by both girls and boys to a greater or lesser degree. The difference simply lies in the frequency of using the aforementioned learning strategies. In Nepalese context, teachers generally prefer more concentration, logical thinking and rehearsal in students' learning of mathematics. However, no attempts have been made for investigation into the effectiveness of the various strategies for enhancing learners' performance in mathematics in terms of gender. Hence, one of the areas for further study is concerned with whether the learning strategies used by girls or those used by boys are more effective for higher achievement.

CONCLUSION:

It seems gender plays some role in learners' ways of interacting with equipment and responding to them. Their perception, motivation, self-related beliefs as well as their emotions also differ. Similarly, there are marked differences between boy and girl students in their interest and enjoyment of mathematics. These factors greatly affect their selection and use of learning strategies. Girls involve in practicing and memorizing more than the boys students. Though they avoid risk taking situation and do not use remarkable effort management and critical thinking, they excel in peer learning and help seeking than boys. However, boys try for alternative methods to solve mathematical problems unlike girls' tendency to memorize and follow their teachers. They even try to solve problems using

worked out examples and show the connection between the ideas learned and the previous knowledge.

The study implies that teachers need to consider gender difference in the selection of learning strategies to motivate and encourage the students according to their preference of learning strategies. But the study has not shown whether the selection of learning strategies impacts on the achievement in mathematics education or not. It has simply opened up a grey area for further research, which needs to be continued in the future. However, it would be relevant to suggest that, in order to improve performance in mathematics in Nepalese context, boys need to participate more in group activities and practice. In the same way, girls need to manage time and study environment to promote their learning achievement in mathematics.

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